Knowledge Capital and Globalisation:
Towards A New Conceptual Model

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1. Introduction

This paper argues that, in conditions of globalisation and of the commodification of scientific knowledge production, conventional approaches to understanding innovation based on the analysis of national systems are inadequate and require extension and development. Freeman first authoritatively articulated the National Innovation System (NIS) concept in 1987 when he analysed Japanese economic performance (Freeman 1987). Lundvall (1992) and Nelson (1993) further developed the concept and their work became the standard references. More recently, attempts have been made to apply the NIS approach to the study of economies in the developing world, particularly the African countries (e.g. Muchie *et al.* 2003).

The NIS perspective emphasises the identification, in any given economic setting, of both the interactions between significant social-economic variables and the dynamic co-evolution of institutions and technologies which together impact to produce key development features and dynamics. In other words, NIS focuses on the existence of collections of *national* systems, operating within multilateral international networks. Such conceptualisations are products of national policy studies approaches. As such, they pose problems in understanding various developments within nation states which are products of more recent globalisation processes. To address this latter-day deficiency this paper adopts a wholly different perspective, paying greater regard to the fact that knowledge formation and innovation occur in the interconnected conditions of both the commodification of scientific knowledge production and globalisation.

The accelerating commodification of scientific knowledge production is a widely discussed phenomenon (e.g. Baskaran and Boden 2006). 'Globalisation' is also well-theorised (e.g. Appadurai 2001) and can be distinguished from national, international and multinational trends in a number of ways. First, globalisation involves the compression of time and space. Second, it generates wholesale flows of, amongst other things, people, capitals, information and knowledge. Third, national sovereignties are transcended as national geographic boundaries/territorialities are breached in a variety of ways. And finally, although globalisation involves an intense level of homogenisation of techniques, policies and practices, these cause local disjunctures at their incidence. This creates dissonance between the global and the local.

These more general characteristics of globalisation have impacted upon knowledge production. This is an inevitability given the centrality of the commodified knowledge product of science in globalised 'knowledge economies'. For instance, information and communication technologies along with globalised corporate organisational forms and practices make it commonplace for scientists to work instantaneously across national boundaries in infinitely flexible ways. Science is now marked by rapid global

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flows of information, data, knowledge and skills (including the people who embody them). As science becomes increasingly commodified (and hence privatised) so it is disassociated from national institutions and policy making interests/control. Finally, knowledge practices have varying local impacts in terms of social change and development – knowledge inflows to any country may cause local disjunctures in, for instance, labour markets, income levels and resource allocation.

Globalisation implies the loss of local control over knowledge capital, the movement of laboratories and people across national territorial boundaries, the development of intellectual property rights regimes attuned to global not local needs and a movement away from the focus of science on local needs. In many senses, global flows of knowledge capital are analogous to the globalisation of financial capital, with similar consequences and dis/advantages.

These developments suggest that there is a need for an enhanced model beyond that offered by the NIS approach. We argue for a model based on the concepts of governance, commodification and globalisation. Our model explicates the lines of tension inherent in this new world regime. We argue that the primary fault-lines are not between the 'West' and the 'Rest' or the North and the South. Rather, they are between competing national interests on one side and globalised actors (particularly multinational corporations) seeking to maximise their advantage on the other.

This paper is organised into five further sections. In section 2, which follows, we briefly rehearse the NIS concept. In sections 3 and 4 we detail how the commodification of scientific knowledge production and globalisation problematise NIS approaches. In section 5 we tentatively propose a model that captures these developments better. This is followed by some conclusions.

2. The National System of Innovation (NIS) Approach

The origins of NIS approaches can be traced to Friedrich List's (1856) concept of the 'national production system' (Freeman 1995). The innovation system concept has subsequently evolved and been deployed to address different problems and areas. NIS has been defined by Patel and Pavitt as

> The national institutions, their incentive structures and their competencies, that determine the rate and direction of technological learning ...in a country (1994:12)

Freeman describes NIS as the way 'resources are managed and organised' in the pursuit of acquiring certain technological capabilities, possibly enabling a country with

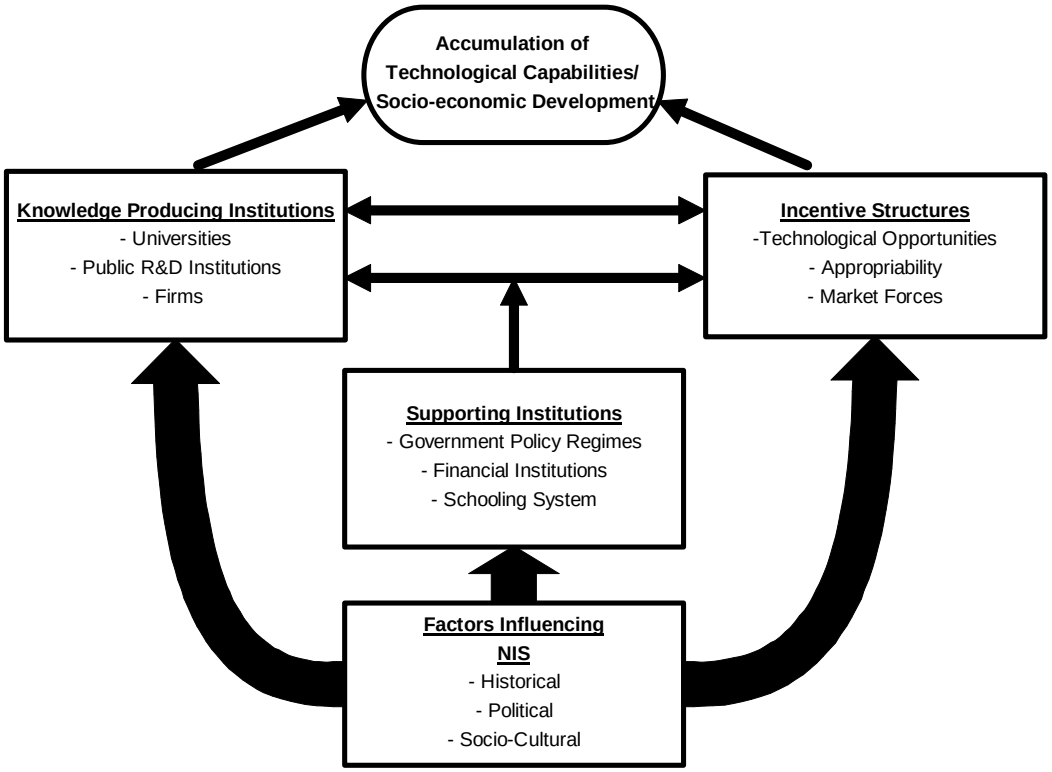
> rather limited resources ... to make very rapid progress ... [but] weaknesses in the national system of innovation may lead to more abundant resources being squandered by the pursuit of inappropriate objectives or the use of ineffective methods. (Industry Commission, Australia 1995:69).

Nelson and Rosenberg (1993:4) define NIS very broadly as the set of institutions and factors whose interactions determine national technological capabilities. They argue

that, in spite of many common features between the systems of the countries with more or less equal economic development, there are also very significant differences attributable to 'national histories and cultures including the timing of a country's entry into the industrialisation process' which influence the evolution of the institutions, laws and policies (1993:18). Put simply, NIS encompasses the institutional structures and systems of incentives that evolve as a direct consequence of socio-economic, political and technical factors (Figure 1).

In other words, NIS suggests that the national innovation systems evolve differently because of a range of different factors in heterogeneous countries. Hence, the rate and direction of technological accumulation will vary across countries as this is contingent upon the nature of the local innovation system. This explains 'why the national system of innovation has worked better in certain environments than in others' (Katz 1994:251). This is illustrated by Figure 1.

Figure 1: Major Elements of National Innovation System (NIS)



Muchie and Baskaran take a more radical view and argue that

> the system of innovation is a concept utilised to describe the relationship between internal processes in firms and external processes in the wider environment in the context of knowledge creation, diffusion, and transfer… within the context of the global market/economy. (2006:31)

They go on

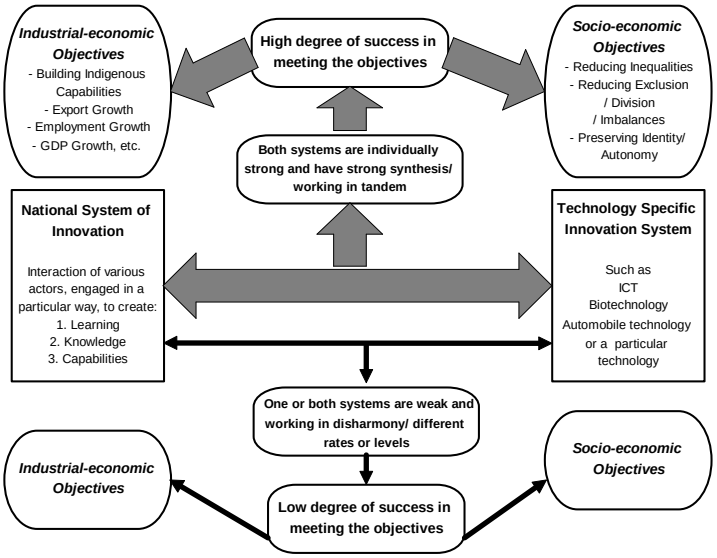
> the innovation system concept makes central, institutions, histories, territories, technologies, organisations and nations that are often neglected and treated as a residual in mainstream neo-classical economics. The concept has evolved by putting innovation and learning at the heart of the economics of development. (2006:33).

Indeed, they argue, the national innovation system

> is not just a tool to achieve the narrow goal of industrial/economic competitiveness, but it is about achieving a broader development and wider social benefits. (2006:33)

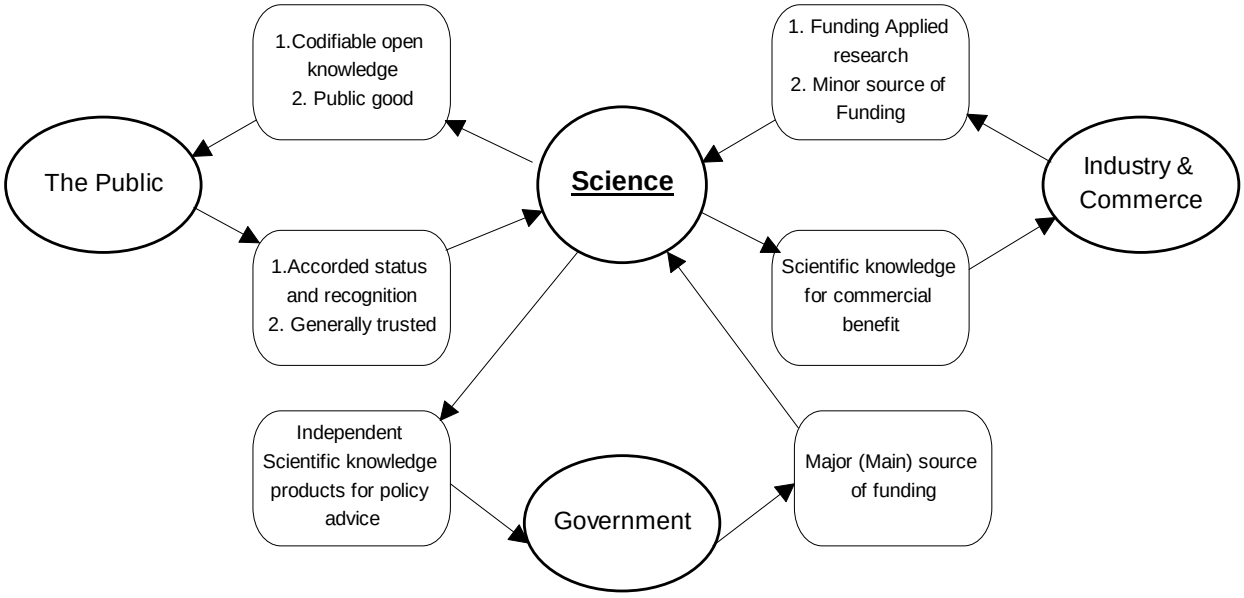
This line of argument illustrated by Figure 2.

Figure 2: Linkages Between Systems of Innovation and Industrial-economic/ Socio-economic Objectives



Source: Baskaran and Muchie (2006)

Figure 3: Traditional Model of Science Knowledge Production



Thus, whilst the mainstream NIS approach is helpful in understanding how various actors in a national setting interact and shape the way capabilities are built, it does not necessarily capture fully all actors and may exclude those external to the nation state in the globalised world such as intellectual property regimes under the WTO, transnational corporations, and non-governmental organisations and campaign groups (domestic and international). In particular, traditional NIS approaches may significantly neglect the importance of both the commodification of knowledge and globalisation.

3. Commodification of Knowledge, States and Economies

In this section we argue that processes of the commodification of knowledge, within neoliberal ideological state regimes, have had a profound effect on national innovation systems. Because science is a social practice, science knowledge products cannot exist independently from the processes that make and shape them.

At the times when the NIS approach was first formulated rather traditional scientific practices, relationships between science and innovation and notions of the role of government prevailed. Nearly all science was practised within 'the sphere of human activities' identified as the independent 'Republic of Science' by Dasgupta and David (1994:487), following Polanyi. Under the traditional model (see Figure 3) of scientific knowledge production, the practice of science is discrete, independent and objective. Its function is to produce codified open knowledge that *might* be economically useful, but could equally have some general, civilising, effect or be useful in government. Scientific knowledge (in fundamental distinction from technology) is not commodity to be economically traded. Rather, in the gift economy of knowledge, scientists receive specific rewards unrelated to the economic usefulness in return for the gift of understanding (Rose and Rose 1969; Anderson 2000)

It is via the process of 'innovation' that the gift of knowledge was expected to flow from the (independent) realm of science to the world of (commercial) technological development and exploitation. According to Rose and Rose

> …innovation depends on a process whereby science continuously transforms and informs technology. (1969:8)

Of course, not all science could lead demonstrably, either in the short or long term, to technological outputs. Nor was it always possible to discern at the outset which scientific knowledge products would prove useful in the development of technology. Implicit here was a separation of science and technology, reified by a division of labour between scientists and technologists.

Thus, the exploitation of scientific knowledge for commercial benefit took place away from the realm of science. Indeed, much of the writing on science and science policy from the 1850's to the 1980's praised Britain's scientific knowledge production whilst bemoaning the inability of "industry" utilise that knowledge by turning it into profitable technology through innovation (see, for example, Wiener, 1981). Under such a model, government both accepts a responsibility for funding science and derives useful knowledge from it. Scientific knowledge products are public or merit goods.

The past two decades in many states are marked by fundamental ideological changes in regimes of government as neoliberal approaches have taken hold. In a subtle contradistinction to classical liberal regimes, neoliberal states see their role as proactively supporting and sustaining the private, wealth-generating, sector whilst running themselves as economically, efficiently and effectively as possible by emulating private sector practices and employing their techniques and technologies (Rose 1996; Dean 1999). Thus the public realm became much more like the private in its ethos and practices, shifting its focus to supporting and facilitating the private sector rather than simply withdrawing to let it have free reign. An important aspect of this shift has been the steady dissolution or attrition of the dichotomous divide between the public and private realms.

In neoliberal states, science has been reconceptualised in various ways congruent with this political ideology (Nedeva and Boden 2006). Perhaps uniquely in the history of science, the development of the 'knowledge economies' and the burgeoning of neoliberal states have generated new exogenous policy-led pressures for change in the vision, institutions and practices of science (Boden, Cox and Nedeva 2006; Nedeva and Boden 2006). The role of the interventionist neoliberal state is now to ensure that science is sufficiently integrated directly into the innovation process to ensure immediate payback for investment in science. This is a change that fundamentally changes the dynamics of any national innovation system, yet one that is usually presented as nothing more than seeking greater synergies and efficiencies.

Science has become a commodity to be traded and exchanged for profit and the principal commodity in the rapidly expanding global free market 'knowledge economies'. Scientific knowledge, rather than being a gift, is ascribed a value, exchanged and made subject to regimes of ownership and/or control. Consequently,

the imperative for scientific knowledge production is increasingly becoming the capacity of such knowledge to create economic wealth through trading in the knowledge economy (Baskaran and Boden 2006). If science knowledge production embodies commodification, we reason, then the resulting knowledge product will reflect that commodification (Law and Akrich 1994).

A consequence of this is the besieging of the Independent Republic of Science by interventionist national science policies driven by the desire to limit the less publicly acceptable aspects of science, to curb science budgets and to direct scientific work towards explicit commercial ends (Dasgupta and David 1994). In other words, neoliberal leaning governments in many developed and developing countries have designed their national science policies to push academic and public R&D much closer to the private sector.

These changes are illustrated by the shift in public funding of R&D in the UK. Table 1 and Figure 4 illustrate the changes in the public R&D funding pattern over the last 10-15 years. Table 1 clearly shows a decline in the overall government funding of public/academic R&D in the UK, from over £3bn in 1992 to less than £1.3bn by 2002. At the same time, funding by business of public/academic R&D has increased, but fluctuates, increasing from £372m in 1993 to £571m in 2000 but the declining to 445m in 2002. This trend is also seen in the case of funding from non-European Union overseas sources to the non-business sector in the UK.[3] This increased from £176m in 1992 to £426m in 2002. Taken together, both business and non-EU funding of public/academic R&D has increased from £548m in 1992 to 871m in 2002.

Figure 4 illustrates government and business funding trends between 1992 and 2002. Government funding fell sharply between 1994 and 1995 and declined steadily since. It is also clear from Table 1 that the government funding to Research Councils has seen little increase and the funding to Higher Education sharply fell from £1801m in 1994 to £161m in 1995. It has only marginally increased during 1999 and 2000 (£258m and £266m respectively) and has declined since then. Of late, the UK government has made attempts to increase public sector investment in science and technology research, but this comes with heavy strings attached with regards to immediate commercial exploitability.

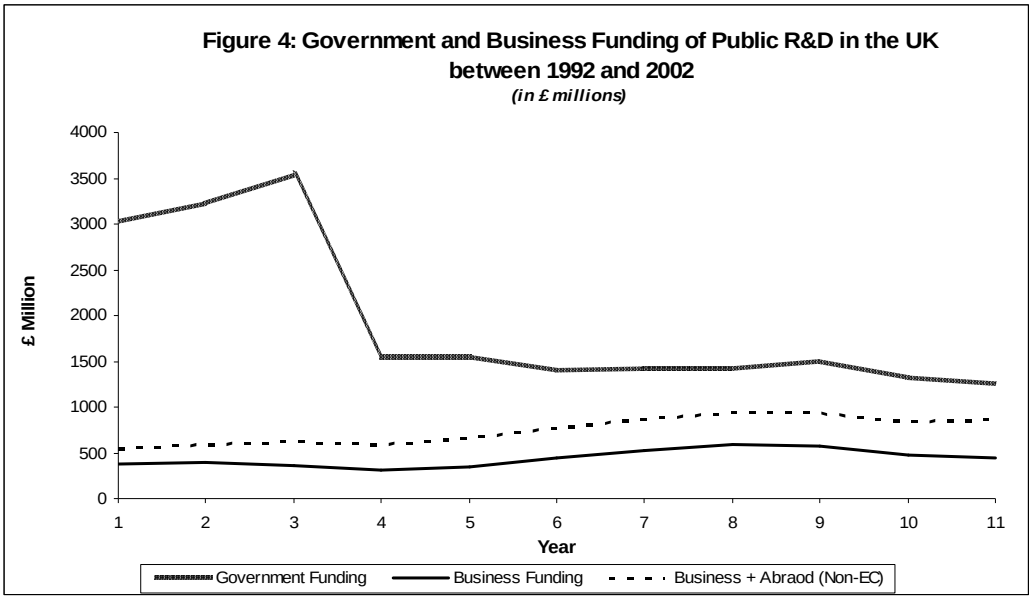
[3] The data for non-EU funding of non-business sector in the UK have been calculated by using the total funding by overseas sources and the funding by EU to the business sector (about 4.6 per cent of the total overseas funding). It is presumed that the non-EU funding sources are largely overseas businesses.

Table 1
Government and Business Funding of Public/Academic R&D in the UK between 1992 and 2002 (*in £ millions*)

Year	Funding by Government				Funding by Business				Funding by Abroad (Non-EC)		*Business + Abroad (Non-EC) Funding to Public R&D*
	Public Sector	*Research Councils*	*Higher Education*	***Total***	*Public Sector*	*Research Councils*	*Higher Education*	***Total***	*To Business*	*To Non-Business*	
1992	1540	--	1493	**3033**	207	--	165	**372**	1212	128	**500**
1993	1633	--	1602	**3235**	214	--	176	**390**	1261	205	**595**
1994	1742	--	1801	**3543**	196	--	157	**353**	1347	266	**619**
1995	1306	83	161	**1550**	105	36	170	**311**	1645	278	**589**
1996	1317	77	157	**1551**	129	35	188	**352**	1887	299	**651**
1997	1166	78	161	**1405**	203	37	205	**445**	1692	321	**766**
1998	1172	76	177	**1425**	260	38	221	**519**	2119	355	**874**
1999	1083	78	258	**1419**	308	48	242	**598**	2433	343	**941**
2000	1138	102	266	**1506**	287	35	259	**581**	2369	366	**947**
2001	937	148	237	**1322**	191	37	250	**478**	2903	363	**841**
2002	863	150	249	**1262**	152	36	257	**445**	3390	426	**871**

Source: Baskaran and Boden (2006a)

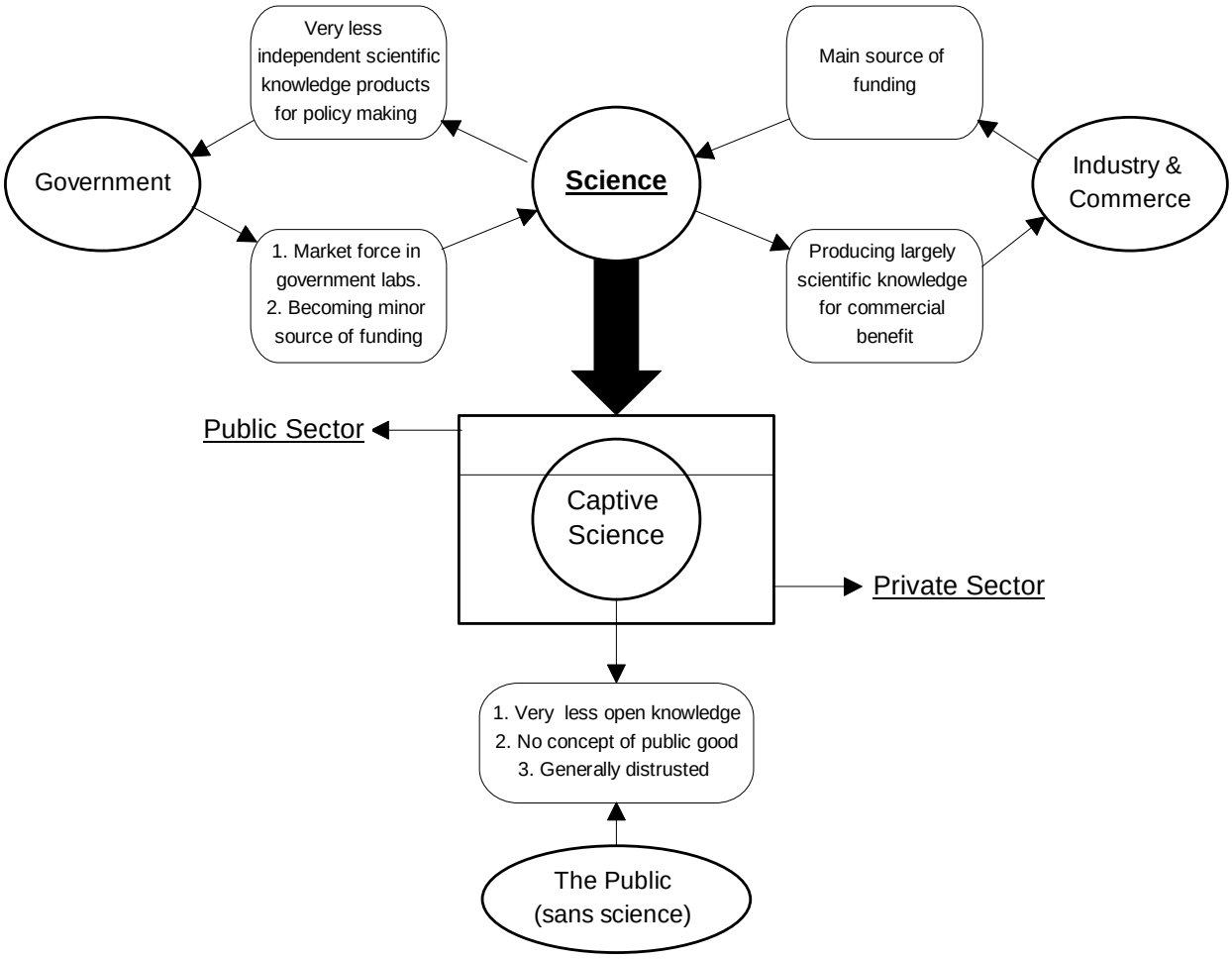
These figures are based on current price. However, they provide significant trends and they do not diminish the relevance of various trends analysed below.



Source: Baskaran and Boden (2006a)

Figure 5: The emerging new model for science in the UK in the 21st century

(driven by mainly economic payoff)



These interventions have resulted in the actual or virtual relocation of science from its discrete 'Republic' to positions firmly within or under the hegemonic control of the public and private sectors. This relocation was achieved through the commodification of the knowledge product of science and has fundamentally altered the social practice of science, disrupting the traditional social contract between scientists and the public under which science produced open, codifiable and trusted knowledge. Figure 5 illustrates the new model.

We argue here the production of open and codified knowledge wanes as scientific knowledge (and the knowledge production process) is transformed into a commodity owned and controlled by those seeking to exploit it. Scientists' rewards are no longer social status and position, but rather are financial and commensurate with the economic usefulness of their knowledge.

The implications for NIS are clear: the state has adopted a much more interventionist role to relocate science in an attempt to ensure that it is a seamless part of the innovation process. As part of that process, science has been commodified and, effectively, privatised. When combined with the processes of globalisation, this can have dramatic effects on the dynamics of national systems of innovation and emphasise the need for revisiting the NIS concept.

4. Globalisation, Commodification and Emergence of New Governance

Globalisation coupled with the information technology revolution has generated global fast-flows of financial capital, trade, information, skills, jobs, and knowledge capital. It has commensurately restricted significantly the autonomy of nation states and undermined their ability to control and manage socio-economic development dynamics. For example, the business process outsourcing (offshoring) has led to a migration of jobs and knowledge capital, mostly from developed countries to developing countries. Governments in these developed countries such as Germany, the UK and the US are almost helpless to prevent this yet face strong criticisms from local politicians, trade unions and the press. Not only less skilled jobs such as call centres, but also high value-added activities such as R&D, engineering and design, knowledge processing and logistics have migrated from OECD to developing countries, such as India, due to the availability of abundant cheap scientific and technical talent and good quality services. Exacerbating this, a large number of science and technology departments in universities are being closed in countries such as the UK due to rapidly declining student demand. These developments have the potential to create socio-economic instability in developed countries. This new phenomenon is an example of how globalisation has thrown up serious challenges to governments and their national systems of innovations not only in the developing world but also in the developed countries.

Globalisation is, unsurprisingly, increasingly seen as

> a definite marker of a new crisis for sovereignty of nation-states, even if there is no consensus on the core of this crisis or its generality and finality" (Appadurai 2001:4).

Globalisation has not had homogenous outcomes across societies, countries, or regions. The flow or movement of finance capital, knowledge capital, and information are not same or spatially consistent and their pattern varies due to differences in local (national) institutional structures. It is argued that

The present system of global governance favours the rich and powerful – the large transnational corporations (TNCs) and rich and powerful nation state (particularly the USA). The poor and the weak (mostly in low-income countries) are placed at a considerable disadvantage, due to the continuing trade discriminations against their export products; existing restrictions on the cross-border movement of low-skilled labour; the creation of 'intellectual property rights' that severely restricts the flow of knowledge, ideas and technology; and, finally, the severe undersupply of such global public goods such as peace, security, equity, health, a healthy global natural environment, and knowledge (Storm and Rao 2004:567). We now consider three issues that demonstrate how globalisation may affect national systems of innovation:

foreign direct investment, intellectual property rights and corporate social responsibility.

Foreign Direct Investment

This is clearly seen from the trends and patterns of internationalisation of R&D through foreign direct investment (FDI). Increasingly FDI is seen as vital by developing countries for employment creation, increasing exports and foreign exchange earnings, technology spillovers and knowledge capital formation to the benefit of the host economy. However, studies reveal mixed results about the technological benefits of FDI to host economies. While some identified positive technology spillovers, others found little or negative effects. It is also argued that publication bias towards studies finding positive technology spillovers by academic journals may have presented a distorted picture (Balasubramanyam and Mahambare 2003:18). Therefore, while attracting FDI is perceived to be an important way to accumulate new knowledge and technology by nation states, it may not lead to intended results for two reasons:

(i) foreign firms are unlikely to voluntarily transfer their technology and know-how as they would like to have monopoly over them;
(ii) the host economy may not have the capability (including R&D and skills) to absorb and benefit from FDI.

In such condition, FDI may prove to be a double edge sword. While it may bring in some benefits, it may also prove to be detrimental to building indigenous capabilities. A study by OECD (2002) highlights both costs and benefits from FDI for host countries, pointing out that apart from a loss of political sovereignty, some countries could fail to witness benefits such as transfer of technology and knowledge, and human capital formation. Various studies suggest that not only the volume and nature of FDI flow varies greatly across the emerging and less developed economies, but also their ability to absorb and benefit from them and enhance their national productive systems varies greatly (e.g. OECD 2002; Wei 2005; Chakraborty and Basu 2002; Rajan 2005).

For example, there has been significant growth in the globalisation of R&D and foreign investment in R&D in India has grown significantly. Beginning in the area of information technology, it has spread to automobiles, pharmaceuticals, and biotechnology sectors. Some multinational companies (MNCs) have also opened their own R&D centres and others have joined hands with Indian firms and organisations. More than 100 MNCs have established R&D facilities in India (UNCTAD 2005). More and more high-tech firms, especially makers of microprocessors, are investing in R&D in Bangalore, India. US chipmaker AMD recently announced it will invest at least 5 million dollars in setting up a design facility in Bangalore that will employ Indian engineers. Other chipmakers Intel and Texas Instruments also set up design centres in Bangalore (See Website A).

Motorola's two research and development facilities in India helped produce a sub-US$40 cellular phone for emerging markets. Microsoft launched its third international research centre in India in 2005. Intel has 800 India-based engineers working on software and hardware designs for its communication and semiconductor product lines. Other U.S. companies are designing everything from auto parts to consumer

electronics in India through outsourcing or setting up their own facilities. These developments are considered just the beginning of advanced research and development in India and they are expected to lead to basic research and product innovation in the future.

However, much of the R&D in India is geared toward smaller projects that complement other innovation centres in Silicon Valley and elsewhere in the world (See Website B). Also, most of this R&D appears to be focused on problem solving for developed markets abroad rather than the domestic one. Although this may change in future, it poses a challenge for the NIS in India and the government as to how manage and integrate transnational R&D with the national system of innovation and production and derive benefit for the national economy.

On the positive side, globalisation of R&D investment has created skilled jobs in India, and it is possible that it may have some spillover effect in the long-term and the some Indian contract research organisations may emerge as manufacturers themselves (Mani 2006). On the negative side, they have contributed to the marginalisation of R&D in traditional technologies (Bowonder 2001).

While the experience of India in benefiting from FDI in the areas of technology and know-how transfer and formation of human capital is mixed with some benefits and some negative impacts, the experience of another major developing country Brazil appears to be very different. Since 19960s and until major liberalisation of its economy in the 1990s under the pressure of globalisation, Brazil made a strong effort to build indigenous technological capabilities in different areas of its national economy. The government invested heavily in building the science and technology infrastructure and skilled human resources. Although FDI and MNCs were allowed in some sectors such as automobile industry, their role was small and limited in the local economy. As a result of this policy approach by the end of 1980s Brazil had developed strong indigenous technological capabilities in a number of sectors such as space, computer, telecommunications and agro-industry. In these sectors government policies protected the local firms from foreign competition to make production rooted in the local innovation system.

Since the early 1990s, Brazil has taken steps to liberalise its economy to attract and increase FDI inflow to encourage local innovations, R&D investment, technology and knowledge transfer by the foreign companies. This policy led to significant increase in FDI inflow – it increased 13 fold in the 1990s compared to that of 1970s. During this time, a number of state owned companies were de-regulated and privatised. The state funding of public R&D institutions and development of skilled human resources witnessed a sharp decline. These developments led to significant changes in the national innovation system. Significant increases in inflows of FDI did not lead to significant increase in technology spillovers and knowledge transfers in Brazil's national economy (Cassiolato et al. 2006). On the contrary, Cassiolato and others argue that:

> The indigenous technological capabilities acquired through decades of hard work are being eroded. The new FDI was most market-seeking and directed to acquisition of existing firms rather than *green field* investment. MNC's subsidiaries acquired important R&D-intensive local firms (in biotech,

> computers, telecom and auto parts, for example) and downgraded their technology efforts. In short, the national innovation system (which continues to be lopsided) is going through a major change in its characteristics (2006:53).

These examples clearly highlight uncertainties and complexities created by globalisation in acquiring technology and knowledge capital through FDI.

Intellectual Property Rights

Another clear example of the erosion of nation states' autonomy can be illustrated by the World Trade Organisation's patent rules governing trade related intellectual property rights (TRIPS) and the global dominance of small number of pharmaceutical corporations. In the pharmaceutical industry, perhaps above all others, scientific knowledge is an absolutely essential commodity. Whilst scientific research and development on drugs *is* highly speculative and costly, there is also evidence that the global pharmaceutical companies effectively deploy these arguments in support of their pricing policies in situations where these factors are not significant. This serves to artificially escalate the price of new drugs. The drug companies also pursue 'market segmentation' pricing policies, fixing the price of their drugs at different levels in different countries, irrespective of actual production costs.

Global trade in pharmaceuticals is effectively controlled through the World Trade Organisation's patent rules governing trade related intellectual property rights — TRIPS. These rules are mainly aimed at protecting MNCs that invest substantially in developing new products and technologies and it is argued that such protection would enable them to invest and move their operations to developing countries and that will benefit their economies through technology spillovers. While theoretically it should work like this, in practice it is more complex. Let us consider the case of South Africa's attempt to provide HIV/AIDS drugs cheaply for its population to demonstrate this complexity and the problem of multinational pharmaceutical corporations' control over scientific intellectual property.

Articles 30 and 31 of TRIPS provide certain exceptions to patent rights and they do theoretically allow countries to procure drugs from cheap sources, that is, to make 'parallel imports' or to make generic versions under 'compulsory licensing' in cases of national emergency (WTO). However, what constitutes a national emergency is a moot point. In general, individual states have their own national legislation which permits the setting aside of TRIPS in certain circumstances. In practice, TRIPS can be used effectively to ban countries from buying medicines from cheap sources. This became evident when South Africa tried to resort to this provision in TRIPS.

Due to the high cost, only a tiny minority of the population in developing countries can afford drugs to treat HIV/AIDS. Faced with a serious HIV/AIDS problem and an inability to procure patent-protected drugs on the world market due to prohibitive pricing, the South African government tried to use the national emergency clause in TRIPS to procure cheap generic drugs from alternate sources such as India. Alarmed by this development, 39 pharmaceutical companies, including large multinational companies such as GlaxoSmithKline, Merck & Co. Bristol-Myers Squibb, Roche, and Boehringer Ingelheim, and acting under the banner of Pharmaceutical Manufacturers Association (PMA), filed a lawsuit against the government of South Africa for

violating their patent rights. These multinational companies are a powerful global force, with a combined market capitalisation ten times greater than South Africa's GNP (*The Independent* 19 April 2001).

The case drew worldwide attention and generated a strong public outcry. Non-governmental organisations such as Oxfam and Medecins Sans Frontieres (MSF) warned of worldwide demonstrations against 'the callousness and bullying' of the drug multinationals (*The Independent* 5 March 2001). Citizens resorted to street protests in several South African cities led by a well-organised South African lobby group, the Treatment Action Campaign (TAC). TAC filed an affidavit in which leading industry researchers swore that a third of life saving drugs developed by pharmaceutical companies in the US received significant amount of government funding. TAC argued that the R&D cost for all five of the main anti-AIDS drugs had been met by American universities or by the US National Institute for Health (NIH), not the drug companies. It was argued that the drug companies had deliberately underplayed the role of public institutions such as the NIH in developing new drugs.

These arguments seriously undermined the drug companies' case, in which they consistently asserted that these drugs were developed following huge private investment. The World Health Organisation and the media in the US and Europe strongly also criticised the action of the drug companies and it soon became clear that even if they had won in the court, the global negative publicity would have serious commercial consequences.

The pharmaceutical firms eventually withdrew their case and subsequently, the British pharmaceutical company GlaxoSmithKline, which had vehemently opposed the South African Government's decision to procure cheap generics, gave a voluntary license on its patents to Aspen Pharmacare, a South African manufacturer of generic drugs. Although drug companies were apparently routed, withdrawing their case and, in many instances, selling their patented medicines at discounted prices to developing nations, the long-term benefit to these countries is still ambiguous. For example, a study by an UN Economic and Social Commission for Asia and Pacific (2001) while highlighting some benefits of TRIPs to India, also acknowledged that the strengthening of patenting will affect Indian pharmaceutical (price and growth) and biotechnology industries.

Corporate Social Responsibility

Globalisation has constrained the autonomy of nation states and their ability to regulate, control, manage, and influence all aspects of economic activities including science knowledge production and transfer, and multinational corporations. This has led to the emergence of new actors and governance mechanisms both at national and international levels. Grassroots protest movements, campaign groups, and non-governmental organisations have emerged to fill this void putting pressure both on nation states and multinational organisations such as World Bank, IMF, G8, WTO, and corporations. For example, the non-government organisations such as Oxfam and Christian Aid have started championing the cause of developing world in the areas such as debt burden, agricultural subsidies in the developed countries and HIV/AIDS drugs. Non-governmental organisations, interest groups, and new mechanisms are emerging as a counter weight to increasingly powerful corporate actors as states are proving to be less influential over them or less willing to restrain them.

Until recently industry, and particularly the big corporations, had been operating on the basis that the point of being in business was to make profit, with little or no regard to the social or environmental costs or responsibilities. But since the mid 1990s, the global community has been increasingly critical of this attitude, particularly when industry started commercially exploiting new sciences such as genetic engineering and biotechnology whilst frequently disregarding the health, moral, and environmental consequences. The public came to distrust not only industry but also science itself and government scientific advisors in many countries have come to be perceived as agents of big corporations – which indeed, under conditions of neoliberalism, they often are. The commodification of scientific knowledge led to a number of controversies such as those over genetically modified organisms, HIV/AIDS drugs, mobile phone radiation, and intellectual property rights affecting the developing world (TRIPS/WTO). Such opposition played a major role in framing debates on corporate social responsibilities. This appears to have forced a rethinking about the role of the industry in a wider society, that is, the corporate social responsibility to the society apart from the traditional responsibility to the share holders. Also, in the face of a declining power equation between nation states and corporations, the notion of 'corporate social responsibility' (CSR), has emerged and took a concrete shape since the late 1990s. The evolution of CSR in the UK is an interesting case.

Until 1995 the concept of social responsibility was given only a little importance in the corporate governance debate in the UK. Neither the corporations nor the governments took the concept of corporate social responsibility seriously until mid-1990s. However, a major change started following the failure of the effort by Shell to dump the Brent Spar oil rig in the North Sea in 1995 due to a strong public outcry and the consequent financial impact on the company from consumer boycotts. Subsequently, facing a strong criticism by campaign groups and some of its own shareholders over the Brent Spar affair, and its controversial role in Nigeria connected with environmental issues and human rights, Shell was forced to publish the first corporate social report by a company in the UK in 1998 showing its social and environmental performance.

Earlier in 1997, due to increasing consumer criticism of the exploitative conditions under which the goods they sell were produced in the developing countries, some corporations including Reebok, Toys'R'Us, Avon, Body Shop and Sainsbury decided to support a verifiable code of conduct called Social Accountability 8000 – an initiative by the Council on Economic Priorities, an American public interest group (*The Independent* 26 October 1997). However, many corporations remained unwilling to take social responsibility seriously. For example, according to Mark Moody-Stuart, the chairman of Shell UK, when the Shell decided to publish a corporate social report, other large international corporations were dismayed and told it 'you must be out of your tiny heads' (*Financial Times* 19 January 1998). Even in 1998 many corporate managers perceived corporate social responsibility as 'a nebulous concept which has little relevance beyond public relations (*The Guardian* 13 June 1998).

However, by the late 1990s the leading multinationals such as BP, IBM, British Telecom, Levis, Nike, Kodak and Monsanto were forced to take CSR seriously due to

pressure from the public and non-governmental organisations such as Green Peace, Oxfam, Amnesty International, and Christian Aid. Particularly, the US giant Monsanto's effort to commercialise genetically modified food and crops led to wide-spread public protest and boycott in Europe due to serious concerns over health and safety. Supermarkets were forced to remove GM products from their shelves and governments were forced to set a moratorium on GM crops. In this process, Monsanto lost significant public trust, leading to serious financial repercussions for the company. In February 1999, a Mori poll in the UK has found that the approval ratings of corporate world was at a 30-year low and a two-third majority of those surveyed felt that corporations paid 'too little attention to their social and environmental responsibilities' (*The Guardian* 18 March 1999).

Fearing consumer backlash, leading corporations were forced to take CSR more seriously. For example, a survey in Europe in 1998 revealed that 70 per cent of businesses believed that 'corporate social responsibility' has become an important business issue. In 1999, a survey of 98 of the FTSE 100 companies (UK) by Pensions and Investment Research Consultants found that 79 of them reported in some way on social and community issues and 14 of them produced dedicated social reports (*The Observer* 27 June 1999). In April 1999, the World Business Council for Sustainable Development (WBCSD), an organisation formed in the run-up to the Rio Earth Summit of 1992 to generate a positive business response to the environmental challenges the summit was addressing, published a report declaring 'CSR is firmly on the global policy agenda'. This showed how rapidly the agenda for CSR has expanded outside the boundary of public donations and environmental issues since early 1990s. By 2001 the big corporations in Europe initiated an 'action plan' for a campaign on CSR and decide to organise a 'CSR Year' in 2005 throughout the European Union.

These three developments and examples illustrate the effects of globalisation on national systems of innovation and highlight the need for new conceptual model for knowledge capital in the globalised world. We attempt to develop such a model in the next section.

5. Knowledge Capital and Globalisation: New Conceptual Model

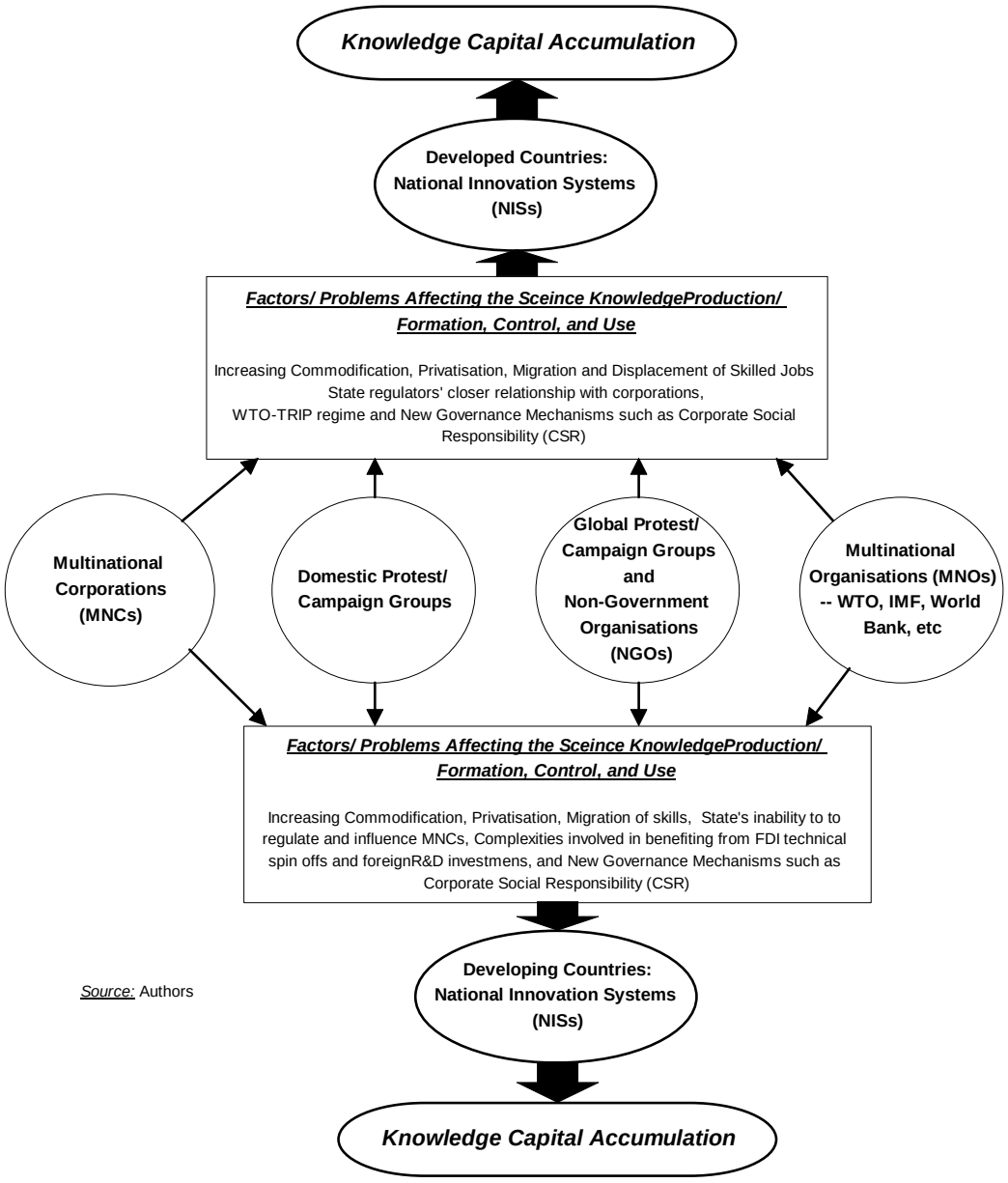
Figure 6 introduces a conceptual model of knowledge capital in the globalised world. It illustrates the complex nature of knowledge accumulation process in the globalised world and highlights how globalisation has created problems for national systems of innovation in both developed and developing countries, some similar and some dissimilar. Similar problems include pressures from privatisation and commodification of science knowledge production and ownership resulting in public scepticism of science and protests from local grassroots organisations and campaign groups. While national systems of innovation in developed countries are facing the problem of skilled job migration, their counterparts in developing countries are facing skilled worker migration. Developing countries are facing disadvantages caused by WTO-TRIPS regime, and the complexities involved in managing and benefiting from FDI associated technical spillovers and knowledge flow. With some exceptions, such as the South East Asian countries, China and India, many countries appear to be not in a position to benefit greatly from FDI flows in terms of accumulating knowledge capital. Although some of these problems or factors such as the ability/ capacity of a

developing country to benefit from FDI flows were present even before the on set of globalisation, they assumed more complexity and importance since globalisation. It is also clear that globalisation has constrained nation states and their ability or willingness to influence multinational corporations, and their autonomy has declined significantly.

This in turn has led to the emergence of new actors both at national and global level such as protest movements, campaign groups and non-government organisations. Their emergence in turn led to new governance mechanisms to restrain and make corporations accountable such as corporate social responsibility.

What becomes clear is that although models such as NIS are helpful in understanding the process of knowledge and technology accumulation, the traditional variants do not capture the all aspects of this process (both internal at national level and external at international level) that is increasingly becoming complex due to globalisation of finance capital, production, trade, research and development, information flow and commodification of science knowledge. The conceptual model introduced here attempts to address this gap.

Figure 6: Knowledge Capital in Globalised World: New Conceptual Model



Source: Authors

6. Some Conclusions

At the outset, this paper argued that the commodification of scientific knowledge production and globalisation demands exploration of a new conceptual model of national innovation systems to aid understanding of knowledge formation and innovation.

We have demonstrated how, in the last two decades, various institutional and funding changes in the public R&D system in many developed countries have led to the commodification of scientific knowledge. That is, science knowledge production and

ownership have undergone a fundamental shift of socio-economic location. The traditional and commodification models of science presented in this paper illustrate this development. The significant and effective privatisation of scientific knowledge is an important development in national systems of innovation.

Commodification led in turn to public scepticism and even hostility towards science which sometimes is expressed through public protests in various forms, such as controversies over GM food and crops, HIV/AIDS drugs, and intellectual property rights (Baskaran and Boden *forthcoming*). Such opposition similarly impacts on governments' ability to regulate the national system of innovation.

Nation states' ability to control, regulate, and manage all aspects of economic activities including science knowledge production and transfers have also been constrained by globalisation, which has engendered fast-flows of financial capital, trade, information, skills, jobs, and knowledge capital. Globalisation has had a differential impact on the national systems of innovation not only withiin developed and developing countries, but also among developed and developing countries. In other words they are not uniform across countries. This is evident from the differences in migration of skilled jobs, skills, and knowledge formation and technology spillovers through FDI, and the impact of intellectual property regime (WTO/TRIPS).

Increasingly, nation states' autonomy to manage their economic affairs including knowledge capital formation and their ability to influence multinational actors such as MNCs are being eroded. Non-state actors such as protest movements, campaign groups, and NGOs have emerged both at national and international level as counter weights to offset the loss of autonomy by the national states. They started putting pressure on nation states and multinational organisations including MNCs which has led to new governance mechanisms such as corporate social responsibility.

These developments demand a new model beyond the NIS approach to understand the formation and flow of knowledge capital in the globalised world. In this paper we have identified that the architecture of such a model has three major actors: (i) National interests and stakeholders (because science takes place on a national stage) who may act with others in international contexts (such as protest movement); (ii) Globalised corporate interests (as the organisations that carry scientific knowledge activity); and (iii) Supra-national organisations that seek to regulate/control globalised and national interests. The nature and the degree of inter linkages between these three actors could determine the nature and rate of knowledge accumulation in a particular country.

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